# Market failure

Market failure arises when the outcome of an economic transaction is not completely efficient, meaning that all costs and benefits related to the transaction are not limited to the buyer and the seller in the transaction. Individual consumers will often purchase goods with an environmental component to make up for their inability to directly purchase environmental goods, thus revealing the value they hold for certain aspects of environmental quality. For example, someone may buy a cabin on a lake in order to enjoy not only the home itself but also the lake's pristine environment. If the individual could exclusively capture the environmental benefits that result from owning the cabin, the demand for cabins would reflect the full value of both the home and the environmental goods it provides, and the market for cabins would be efficient. Unfortunately, in the case of environmental goods, markets often fail to produce an efficient result, because it is rare that any one individual can incur the full benefit, as well as the cost, of a particular level of environmental quality. That is because environmental goods commonly suffer from the presence of externalities (that is, consequences that no one pays for) or a lack of property rights.

There are two types of externalities, negative and positive. Negative externalities exist when individuals bear a portion of the cost associated with a good's production without having any influence over the related production decisions. For example, parents may have to pay higher health-care costs related to pollution-induced asthma among their children because of increased industrial activity in their neighbourhood. Producers do not consider those costs to others in their decisions. As a result, they produce more goods with negative externalities than is efficient, which leads to more environmental degradation than is socially desirable.

Positive externalities also result in inefficient market outcomes. However, goods that suffer from positive externalities provide more value to individuals in society than is taken into account by those providing the goods. An example of a positive externality can be seen in the case of college roommates sharing an off-campus

apartment. Though a clean kitchen may be valued by all the individuals living in the apartment, the person who decides to finally wash the dishes and scrub the kitchen floor is not fully compensated for providing value to all the roommates. Because of that, the decision to clean the kitchen undervalues the benefits of such an action and the kitchen will go uncleaned more often than is socially desirable. Such is the case with environmental quality. Because markets tend to undervalue goods with positive externalities, market outcomes provide a level of environmental quality that is lower than is socially desirable.

### Corrective instruments

Once the market inefficiency relating to a particular environmental good is understood, policy makers can correct for the inefficiency by employing any number of instruments. Regardless of the instrument, the goal is to provide incentives to individual consumers and firms so that they will choose a more efficient level of emissions or environmental quality.

### Command and control

Command and control is a type of environmental regulation that allows policy makers to specifically regulate both the amount and the process by which a firm should maintain the quality of the environment. Often it takes the form of a reduction of emissions released by the firm during the production of its goods. This form of environmental regulation is very common and allows policy makers to regulate goods where a market-based approach is either not possible or not likely to be popular.

## The Coase theorem

British American economist Ronald Coase developed the Coase theorem in 1960, and, although not a regulatory framework, it paved the way for incentive-driven, or market-based, regulatory systems. According to the Coase theorem, in the face of market inefficiencies resulting from externalities, private citizens (or firms)

are able to negotiate a mutually beneficial, socially desirable solution as long as there are no costs associated with the negotiation process. The result is expected to hold regardless of whether the polluter has the right to pollute or the average affected bystander has a right to a clean environment.

Consider the negative externality example above, in which parents face soaring health care costs resulting from increased industrial activity. According to the Coase theorem, the polluter and the parents could negotiate a solution to the externalities issue even without government intervention. For example, if the legal framework in society gave the firm the right to produce pollution, the parents with sick children could possibly consider the amount they are spending on medical bills and offer a lesser sum to the firm in exchange for a reduced level of pollution. That could save the parents money (as compared with their health care costs), and the firm may find itself more than compensated for the increased costs that a reduction in emissions can bring.

If it is the parents instead who have a right to clean, safe air for their children (this is more typically the case), then the firm could offer the parents a sum of money in exchange for allowing a higher level of pollution in the area. As long as the sum offered is less than the cost of reducing emissions, the firm will be better off. As for the parents, if the sum of money more than compensates the health care costs they face with higher pollution levels, they may also find themselves preferring the negotiated outcome.

Unfortunately, because the Coase theorem's fundamental assumption of costless negotiation often falls short, the theorem is not commonly applicable as a real-world solution. Nevertheless, the Coase theorem is an important reminder that, even in the case of complex environmental problems, there may be room for mutually beneficial compromises.

## Taxation

In 1920 British economist Arthur C. Pigou developed a taxation method for dealing with the goods suffering from externalities. His idea, now known as the Pigouvian tax, is to force producers to pay a tax equal to the external damage caused by their production decisions in order to allow the market to take into

consideration the full costs associated with the taxed goods. This process is often referred to as internalizing an externality. Of course, because the amount of the tax must equal the value of the external environmental damage in order to correct for market inefficiencies, the valuation techniques detailed above are crucial in developing a sound tax policy.

This concept can also be applied to goods that suffer from positive externalities. However, in this case a negative tax (or subsidy) is provided to allow an individual to gain an additional benefit from providing the subsidized good. A common example of this type of subsidy is when an individual receives a tax break for purchasing an exceptionally energy-efficient household appliance.

# Permit markets

The concept of using a permit market to control pollution levels was first developed by Canadian economist John Dales and American economist Thomas Crocker in the 1960s. Through this method, pollution permits are issued to firms in an industry where a reduction in emissions is desired. The permits give each firm the right to produce emissions according to the number of permits it holds. However, the total number of permits issued is limited to the amount of pollution that is allowed throughout the industry. This means that some firms will not be able to pollute as much as they would like, and they will be forced to either reduce emissions or purchase permits from another firm in the industry (*see also* emissions trading).

Those firms that can reduce their emissions for the lowest possible cost benefit from this type of regulation. Firms that emit less can sell their permits for an amount greater than or equal to the cost of their own emissions reduction, resulting in profits in the permit market. However, even firms for which it is very costly to reduce pollution experience a cost savings through permit markets, because they can purchase pollution permits at a price that is less than or equal to the taxes or other penalties that they would face if they were required to reduce emissions. Ultimately, permit markets make it less costly for an industry to comply with environmental

regulations and, with the prospect of profits in the permit market, this type of regulation provides an incentive for firms to find cheaper pollution-reducing technologies.

Environmentalists have called for the creation of local, regional, and international permit markets to address the problem of carbon emissions coming from industrial facilities and electrical utilities, many of which burn coal to generate electricity. Dales and Crocker argued that applying permit marketing to issues of global warming and climate change, an idea called "cap and trade," could be most useful in situations where there are a limited number of actors working to solve a discrete pollution problem, such as pollution abatement in a single waterway. Carbon emissions, however, are produced by numerous utilities and industries in every country. Creating international rules to address global carbon emissions that all actors can abide by has been problematic because rapidly developing countries—such as China and India, which are among the world's largest producers of carbon emissions—view restraints on carbon emissions as impediments to growth. As such, developing a carbon market made up of willing players alone will not solve the problem, since any progress made to staunch carbon emissions by industrialized countries will be offset by those countries that are not part of the agreement.

## Examples of regulation using corrective instruments

The implementation of the Clean Air Act of 1970 represented the first major application of the concepts of environmental economics to government policy in the United States, which followed a command-and-control regulatory framework. This law and its amendments in 1990 set and strengthened strict ambient air quality standards. In some cases, specific technologies were required for compliance.

After the Clean Air Act Amendments of 1990, pollution taxes and permit markets became the preferred tools for environmental regulation. Although permit markets had been used in the United States as early as the 1970s, the Clean Air Act Amendments of 1990 ushered in an era of increased popularity for that type of regulation by requiring the development of a nationwide permit market

for sulfur dioxide emissions, which, along with laws requiring the installation of filtering systems (or "scrubbers") on smokestacks and the use of low-sulfur coal, reduced sulfur dioxide emissions in the United States. Additional programs have been used to reduce ozone-related emissions, including California's Regional Clean Air Incentives Market (RECLAIM), established in the Los Angeles basin, and the Ozone Transport Commission $NO_x$ Budget Program, which considers various nitrogen oxide ($NO_x$) emissions and spans 12 states in the eastern United States. Both of those programs were originally implemented in 1994.

The Ozone Transportation Commission program aimed to reduce nitrogen oxide emissions in participating states in both 1999 and 2003. The results of the program, as reported by the Environmental Protection Agency, included a reduction in sulfur dioxide emissions (as compared with 1990 levels) of more than five million tons, a reduction in nitrogen oxide emissions (as compared with 1990 levels) of more than three million tons, and nearly 100 percent program compliance.

Finland, Sweden, Denmark, Switzerland, France, Italy, and the United Kingdom all made changes to their tax systems in order to reduce pollution. Some of those changes include the introduction of new taxes, such as Finland's 1990 implementation of a carbon tax. Other changes involve using tax revenue to increase environmental quality, such as Denmark's use of tax revenue to fund investment in energy-saving technologies.

In the United States, local grocery markets are at the centre of a large tax system aimed at reducing environmental degradation—the deposit-refund system, which rewards individuals who are willing to return bottles and cans to an authorized recycling centre. Such an incentive represents a negative tax to individuals in exchange for recycling behaviour that benefits society as a whole.

## Policy implications

The policy implications of work done by environmental economists are far-reaching. As countries deal with issues such as water quality, air quality, open space, and global climate change,

the methodologies developed in environmental economics are key to providing efficient, cost-effective solutions.

Although command and control remains a common form of regulation, the above sections detail ways that countries have used market-based approaches such as taxation and permit markets. Examples of those types of programs continued to develop in the early 21st century. For example, in an attempt to comply with the provisions of the Kyoto Protocol, which was implemented to control greenhouse gas emissions, the European Union established a carbon dioxide permit market aimed at reducing greenhouse gases.

Even the Coase theorem has been applied as global environmental problems demand mutually beneficial agreements to be voluntarily negotiated between countries. The Montreal Protocol, for example, which was implemented to control emissions of ozone-depleting chemicals, uses a multilateral fund that compensates developing countries for the costs incurred in phasing out ozone-depleting chemicals. That approach is very similar to the one in which parents in a community may find it beneficial to compensate a polluting firm for reducing emissions.